Spring 2013

Squalicum Creek re-route

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Squalicum Creek Re-Route

Environmental Impact Assessment (ENVS493)

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Spring 2013

Western Washington University

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Environmental Impact Assessment
Huxley College of the Environment

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Date 3 June 2013

HUXLEY
COLLEGE OF THE ENVIRONMENT

Dear Concerned Citizen:

The *Squalicum Creek Re-route* Draft Environmental Impact Assessment is enclosed for your review. The draft analyzes the environmental effects of a new proposed route for Squalicum Creek around Sunset Pond and north of the existing channel in Bellingham, Washington, along with two alternatives; one of which proposes no change to the current course. This re-route is intended to improve water quality, and the stream channel to provide habitat and spawning areas for native fish species. Your comment and reviews on the proposed changes, as well as your advice on the accuracy and adequacy of the analysis, would be most helpful.

The proposed changes are intended to improve salmon habitat and reduce predation by warmwater fish species by rerouting the creek to avoid Sunset Pond and pass through a modified channel in Bug Lake. The construction of these water bodies altered Squalicum Creek's historical floodplain and exposed native fish species to increased predation and competition for resources.The proposed changes will increase the survival rates of juvenile salmon, including several federally threatened species.

Thank you for your time, attention, and thoughts on the *Squalicum Creek Re-route*.

Sincerely,

Katherine Hales
Cecily Kowitz
Dylan Peterson
Lisa Sulenes
Skylar Sumner

Project Title
The Squalicum Creek Water Quality and Biotic Integrity Improvement Project

Description of the Proposal
The Squalicum Creek Water Quality and Biotic Integrity Improvement Project will create a productive and functional ecosystem complete with floodplains, wetlands, and riparian area. This new system will replace a series of artificial ponds and streams dug out during the construction of Interstate 5 (I-5) that has resulted in poor water quality and reduced habitat for native fish by increasing predation and decreasing conveyance.The project is composed of a series of improvements to existing structures and stream beds as well as the addition of new channels and wetland complexes which will reduce stream temperatures, increase flood accommodation and improve valuable fish habitat along the creek channel.

Location
A tract of land situated in the southeast quarter of section 18 and the southwest quarter of section 17, township 38 north, range 3 east, W.M., City of Bellingham, Whatcom County, Washington. The area falls between Woodstock way to the south and Orchard Drive to the north, crossing under James street and I-5 at mile marker 255 containing 15.35 acres more or less.

Implementation Date
Construction is anticipated to begin in the summer of 2014. The peak flow in late summer will still follow the old route, but the Sunset Pond plug would be constructed in 2015, thereby diverting Squalicum Creek into the newly constructed channel. All three phases of this project are anticipated to be completed by 2017.

SEPA Lead Agency
City of Bellingham (COB)

Project Information Contact Person
Renee Lacroix: Project Manager -Public Works and Natural Resources

Permits Required
Must obtain Section 106 Archaeological Review and Clean Water Act (CWA) Section 404 permits from the US Army Corps of Engineers (USACE). Required review under Endangered Species Act by National Marine Fisheries Service(NMFS) and the US Forest Service. Since Squalicum Creek is an impacted water body, Washington Department of Ecology (DOE) must approve a National Pollutant Discharge Elimination System(NPDES) construction permit and Section 401 Water Quality Certification. Approval by the City of Bellingham is also required through the Shoreline Master Program and a Critical Areas review.

Contributors
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Distribution List
Jean Melious; Wilson Library; Katherine Hales, Cecily Kowitz, Dylan Peterson, Lisa Sulenes, Skylar Sumner; Renee Lacroix

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Executive Summary

Squalicum Creek is one of the largest independent drainages in Whatcom County, draining most of Northern Bellingham. The creek originates in the Cascade foothills and empties into Bellingham Bay. Squalicum Creek has the highest potential for high water quality and productive fish habitat within the Bellingham city limits. The location of the creek is shown in Figure 1 with the reach addressed in this document highlighted as the Project Area. Current conditions within the project area impede fish passage and provide few spawning areas. In addition, Bug Lake and Sunset Pond currently create the highest thermal loading in Squalicum Creek. The creek also fails to meet water quality standards for dissolved oxygen (DO) and fecal coliform. The proposed action will improve water quality and native fish habitat as well as reduce predation by non-native species.

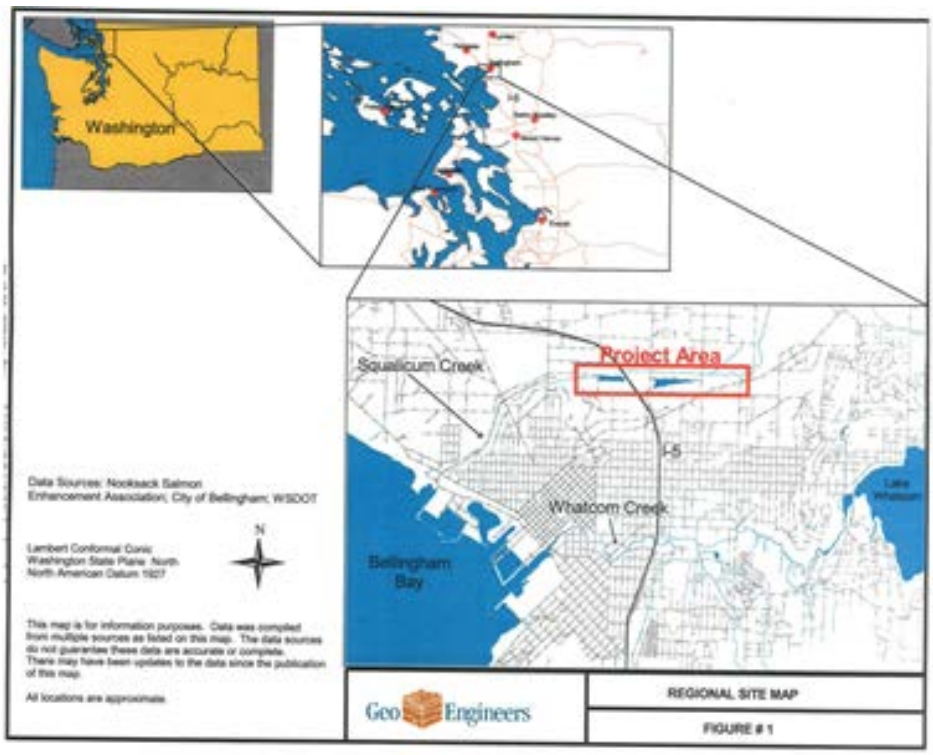

Figure 1. Map showing location of proposed project area located within Whatcom County

This report examines three possible outcomes: the proposed action, an alternative action and a no-action alternative. The proposed action involves creating a new stream channel to route the creek around Sunset Pond. The creek will maintain its route through Bug Lake; however, it will be partially filled to create wetlands and a narrower and more complex stream channel. Increased riparian zones and installations of large woody debris (LWD) in the creek will improve water quality, stream complexity, and provide resting spaces for fish. This plan also includes the modification of existing and construction of new in-stream structures to improve fish passage by enabling salmon to out-migrate as juveniles and move upstream to spawning grounds as adults.

The alternative action proposes to fill in large portions of both Bug Lake and Sunset Pond, leaving a narrow channel and transforming the remaining pond areas from manmade aqueducts to riparian areas

and emergent wetlands. Riparian planting would also be added around the current stream channel between the lakes and fish passage barriers improved to facilitate fish migration.

The no-action alternative would leave the creek in its current condition, leaving habitat issues unresolved.

Adverse impacts from the proposed project include increased sediment loading and stormwater pollution from surrounding current and future development as well as disruption of some existing wetland areas. Water quality benefits from the lakes during high flows would also be lost. Temporary impacts as a result of infrastructure and channel improvements would be mitigated by the addition of engineered wetlands as well as continued monitoring, adaptive management strategies and education and outreach efforts to prevent further contamination via stormwater. Short term increased sediment loading during construction cannot be completely mitigated and will have potential significant adverse effects such as increased turbidity, temperature, and lowered dissolved oxygen levels which could be harmful to fish remaining in the stream. Long term goals of the project will improve these temporarily decreased water quality parameters.

Impacts of the alternative action would be similar to the proposed action. There are additional potential impacts from non-native soils and even more sediment loading during construction from filling in the ponds. The alternative does not improve floodplain conveyance, though increased wetlands will help manage high-flow conditions. This alternative requires very little new infrastructure.

Some supporters of the proposed Bay to Baker Trail disapprove of the current Squalicum Creek re-route because the new channel would follow the old Burlington Northern Railroad grade, which was the original location for the Bay to Baker Trail. If the re-route is completed, then the trail would have to circumvent the bridge by following James Street to the nearest intersection at McLeod Rd. These supporters claim that the Bay to Baker Trail deserves priority since that project's development began years ago. In addition, some members of the community disagree over the future recreation use of Sunset Pond.

1.0 Project Overview

This section will introduce the site and give an overview of existing conditions and the three alternatives.

1.1 History of Site

Squalicum Creek has been significantly altered from its natural state since Euro-American contact. Nearly all the native forests around the creek have been cleared for timber or agricultural use, and two railroad lines were routed through the Squalicum Creek valley in the late 19th century. In the 1960s and '70s the construction of Interstate 5 (I-5) had significant impacts on the course and ecological conditions of the creek. Two gravel pits were dug to obtain construction materials for I-5, and the creek was routed to flow through them, creating Bug Lake and Sunset Pond. The creek channel was further modified as transportation routes and industrial centers were constructed in the creek's floodplain. Culverts have also been put in place to route the creek around transportation corridors and prevent creek migration.

Figure 2. View of Bug Lake

Historically, Squalicum Creek has been inhabited by coho and chum salmon. Beginning in the 1930s, it was stocked with sea run cutthroat and steelhead trout, though this was discontinued in 1988 due to the potential for competition with the system's resident salmonids. A number of warm water fish species have also been introduced to the stream system, perhaps through upstream tributaries and private lakes.

1.2 Existing Conditions

Although Squalicum Creek has the highest potential for fish habitat and high water quality within Bellingham's city limits, it is currently impaired by a number of issues including warming from man-made ponds, fish passage blockages, and predation on native salmonids. The creek is on Washington State's 303(d) list of impaired water bodies, meaning that it has been determined to be highly polluted and requires a cleanup plan according to section 303(d) of the Clean Water Act. Squalicum Creek has

been given a Category 5 designation for dissolved oxygen (DO), temperature and bacteria, meaning that a water cleanup plan or Total Maximum Daily Load (TMDL) is required.

Land use around the project area varies along the stretch of the creek but is mostly residential, institutional and industrial zoning with some public lands to the north of the ponds where the proposed stream channel will be built (Figure 3). Much of the land designated for industry is undeveloped. A portion of the industrially zoned land upstream of the lakes will be converted to a public park by the city. Some of the land along the reach from Sunset Pond inflow to James Street is being used for small-scale agriculture and pasture land.

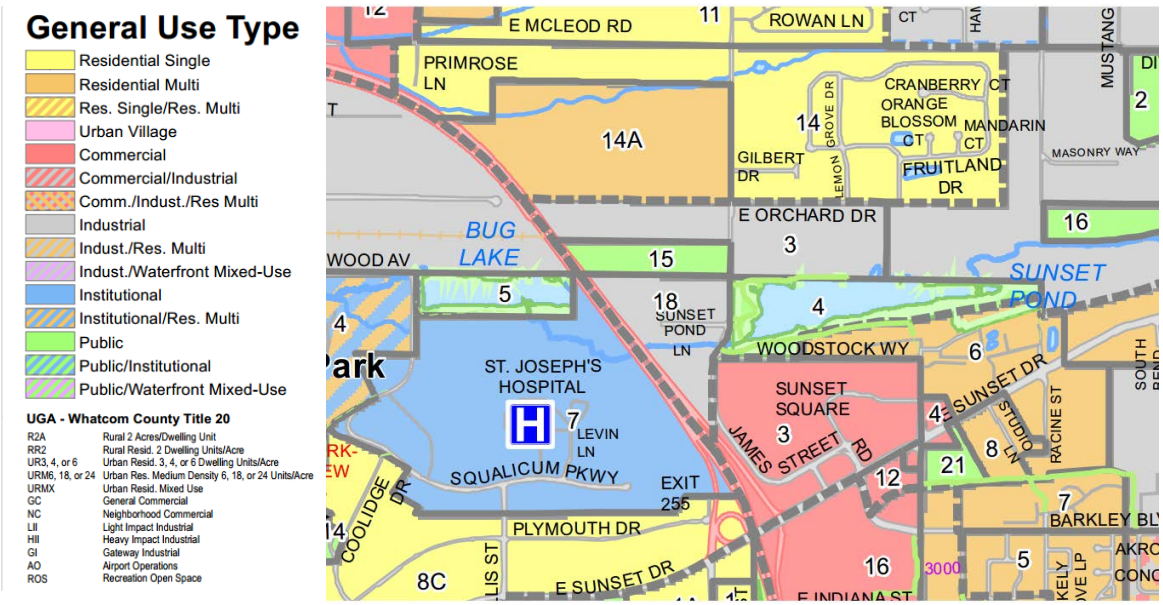

Figure 3. Image from COB Zoning Map showing project area and surrounding land use zone (COB).

1.3 Proposed Action

The proposed action is to re-route Squalicum Creek to avoid temperature and predation impacts from two man-made water bodies: Bug Lake and Sunset Pond. The new channel would be excavated north of Sunset Pond to flow under James Street and I-5 before entering Bug Lake's northern shore. This proposed route would also reconnect two tributaries (Tributary W and Tributary V) that had previously been separated from the main channel.

Bug Lake would then be partially filled with sediment removed from the channel to reduce it from an almost stagnant lake to a more rapidly flowing stream (see Figure 4). Wetlands and new stream channels would be developed in place of the old pond. Not only would this reduce temperature and predation impacts in Squalicum Creek, but it would also replace wetlands harmed during the construction of I-5

The plan for Sunset Pond is more complex than that of Bug Lake. After the completion of the new creek channel, the creek inlet to the pond will be plugged to send the water flow north through the channel, while the pond outlet will be plugged to stop water flow from Sunset Pond into Bug Lake. The eastern portion of the pond will be partially filled to create navigable wetlands with potential for recreational activities, such as canoeing, kayaking, and fishing. An empty channel from the new creek route to the northeastern corner of the pond will remain as a high-flow spillway, allowing the pond to continue to

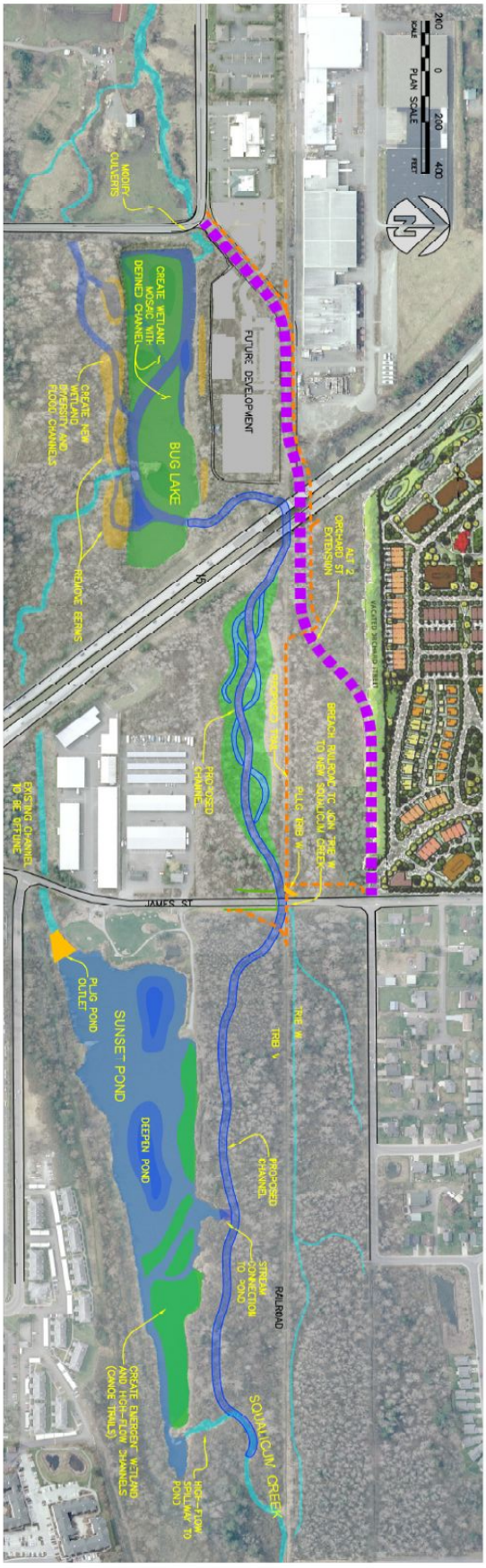

Figure 4. Map of entire extent of proposed action, including other City projects in the area (COB).

serve as a catchment for flooding events (see Figure 4). That portion of the pond which is not filled and converted to wetland will be deepened in order to decrease temperatures and allow for water storage.

Before the construction of I-5, the valley was dominated by riparian vegetation and wetlands. However, construction of the Burlington Northern Railroad (BNRR) grade, excavation of the two ponds and other modifications to the valley have disrupted or removed natural existing wetlands. This proposed action includes plans for three new wetland areas surrounding the creek. The filling of Bug Lake will create a diverse floodplain around the remaining channel. The wooded area surrounding the proposed channel will also develop characteristics more representative of a wetland due to the increased hydrological activity from Squalicum Creek and allow for natural stream migration. Finally, the portions of Sunset Pond near the current spillway will be partially filled, turning the warm-water pond into a saturated wetland ecosystem.

This project will also include the construction of three new bridges: one at James street and two at the BNRR grade. The project will also require the installation of two flood weirs: one to bisect Bug Lake, isolating the new stream channel from the southern portion of the pond while still allowing for flood overflow; the other between the new stream channel and Sunset Pond to allow for overflow during high flows.

Since this is an environmental restoration project, State Environmental Policy Act (SEPA) requires a 1:1 ratio of impacted wetlands to preserved wetlands. The wetlands developed in Sunset Pond and Bug Lake will not only replace wetlands impacted during stream construction but will also replace those disturbed during the construction of I-5 and excavation of the lakes.

1.4 Alternative Action

The alternative to the proposed action avoids constructing a new stream channel above Sunset Pond. In this alternative, Squalicum Creek will keep the existing route through Sunset Pond and Bug Lake. Sunset Pond will be partially filled in to create a narrow channel through the pond which will be deepened to account for water volume and flooding. Filled-in portions of Sunset Pond will be transformed into wetlands, similar to the proposed action for Bug Lake. Bug Lake will be filled in similarly to the proposed action, with the only change being the location of the channel to maintain the current input and output of the lake. The fill will come from outside sources, preferably similar to the native soil. Native plants will be added to the wetlands to create new habitat and appropriate shading.

The goal of this alternative is to improve the water quality and habitat for native fish in both the lake and the pond, while not drastically re-routing the creek. By decreasing the width of the creek, the speed of the flowing water will increase and be less likely to heat up as it flows into Sunset Pond and Bug Lake areas. The addition of wetlands and habitat will increase the amount of DO. The change in water quality will decrease habitat for non-native trout and reduce predation on salmonids. This alternative also avoids interference with the Parks and Recreation Department's proposed Bay to Baker Trail that will go in north of the ponds.

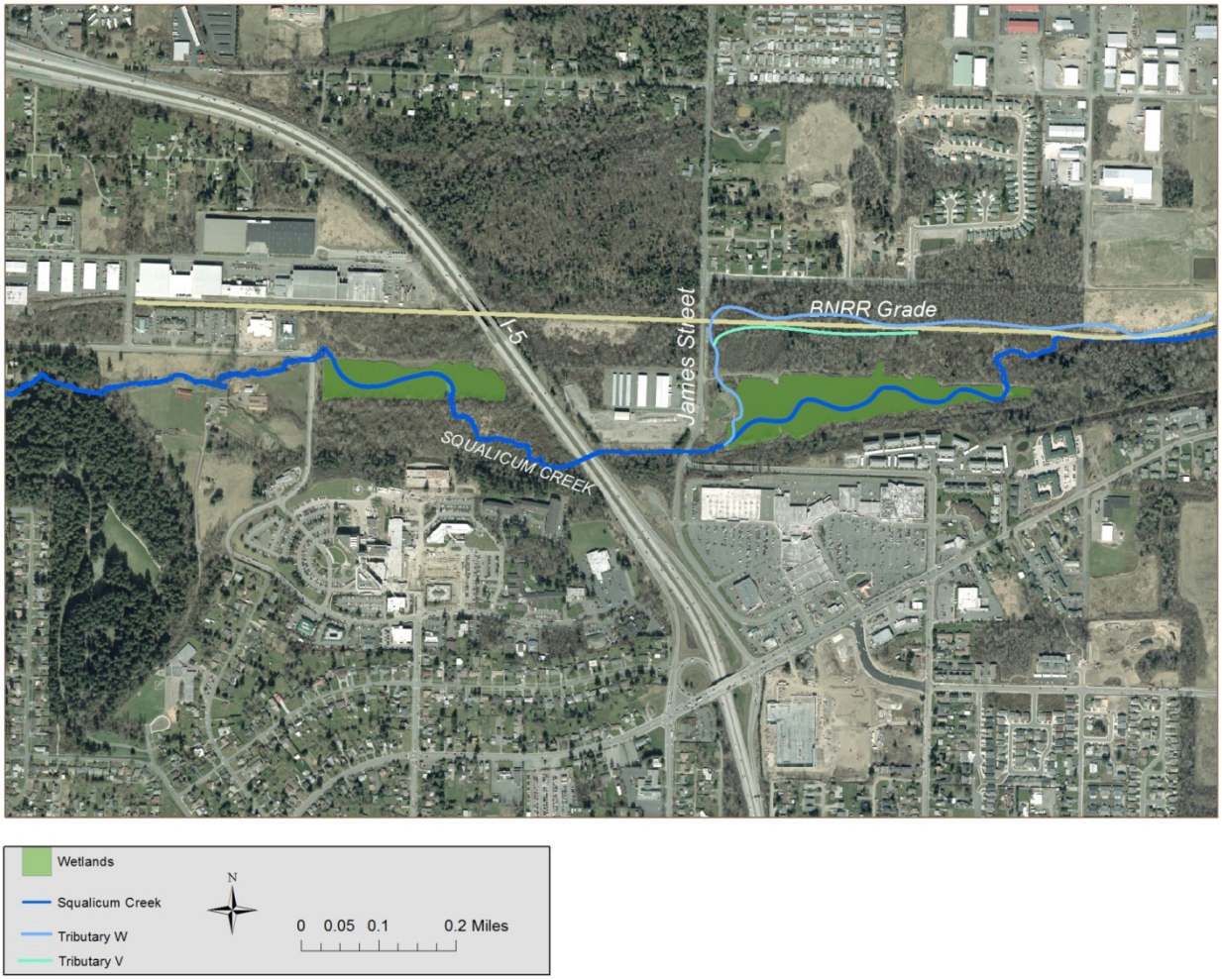

Figure 5. Conceptual design of alternative action.

1.5 No-Action Alternative

Under this alternative, no new action will be taken on Squalicum Creek. Current monitoring efforts will be continued, but the course of the stream will not be disturbed. Current issues, including predation on native salmonids, barriers to fish passage, erosion, and water quality issues, will not be resolved. No new government action will be taken; however, TMDLs will still be required under section 303(d) of the Clean Water Act.

2.0 Impacts to the Natural and Built Environment

Elements of the natural and built environment, as outlined in WAC 197-11-960, affected by short-term restoration processes and construction impacts of the proposed action, alternative action, and no-action alternative are listed below.

2.1 Water

This section will describe current water quality conditions and stormwater impacts. Significant impacts from each alternative action including mitigation measures to reduce impacts will be described.

2.1.1 Existing Conditions

The purpose of the Squalicum Creek re-route is to improve water conditions in the creek; thus, hydrological impacts will be some of the most important considerations in this assessment. The project centers around Squalicum Creek, a tributary of Bellingham Bay located 2.5 miles east of the Nooksack River delta. The Squalicum Creek watershed drains 22 square miles of terrain (figure 5). In the area that will be affected by the project, Squalicum Creek runs through Bug Lake and Sunset Pond, both of which are shallow and warm, with the effect of contributing significantly to water quality issues in the creek. The valley in which this project will be located is almost entirely wetland, and a Federal Emergency Management Agency (FEMA) 100-year floodplain is associated with the creek throughout the reach of the project (figure 6).

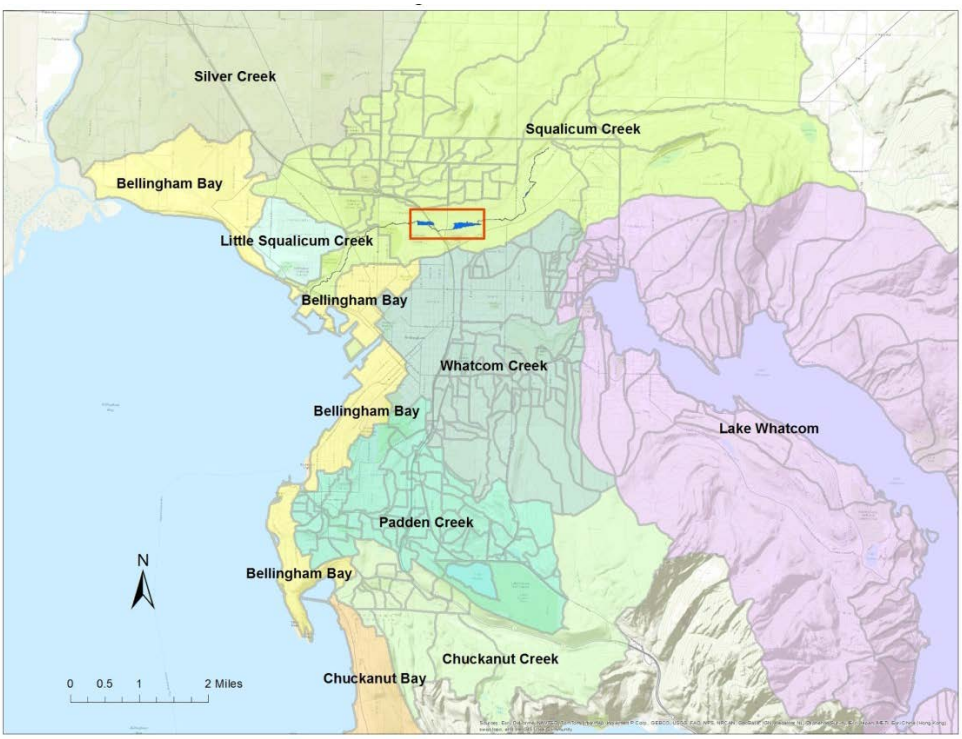

Figure 6. Watersheds in Bellingham, showing the extent of the Squalicum Creek drainage. The project site is outlined in red. Map created by Katherine Hales.

The existing water conditions for this section of Squalicum Creek are the driving force for the proposed action. Bug Lake and Sunset Pond currently create the highest thermal loading in the creek during summer months when the ponds become stratified. The temperatures during these times are near lethal levels for salmon. Higher temperatures force salmon into cooler deeper waters, exposing them to higher predation risk. During low flow conditions low DO levels have been observed as well as high fecal coliform levels during storm flow conditions.

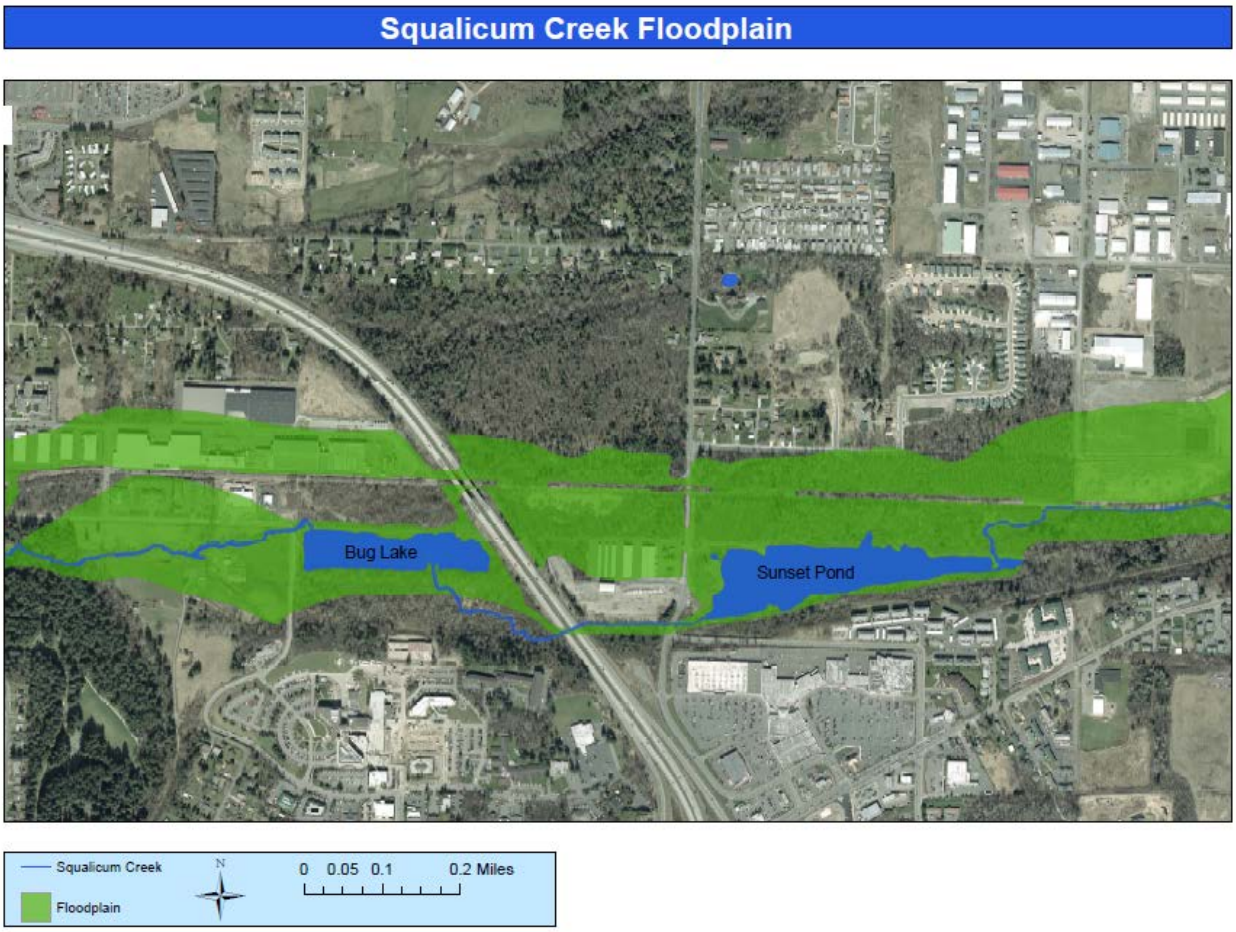

Figure 7. Aerial photos of site showing overlay of floodplain area.

The creek is listed on the Washington State Department of Ecology's 303(d) list for exceeding temperature, DO and fecal coliform standards. Data from the City of Bellingham's Urban Streams Monitoring Program show that the stream frequently did not meet temperature, DO, or fecal coliform criteria for Aquatic Life Uses (ALU) for Core Summer Habitat between 1991 and 2009. These data are summarized in table 1.

Industrial and agricultural areas along with impervious surfaces result in polluted stormwater runoff which contributes to water quality problems in the creek. These contaminants may include but are not limited to fecal coliform from animals and septic systems, pesticides and fertilizers, metals and oil from vehicle traffic. Future development in the watershed may also increase the impacts from runoff leading to greater flood risk and input of additional contaminants from increased land use. These inputs may have negative impacts on the fish and habitat of the creek. An off-leash dog park located adjacent to Bug Lake also contributes to increased fecal coliform in the stream that may pose a health hazard to children and other animals accessing the water, particularly in summer months.

Table 1. Water quality parameters from sampling sites upstream and downstream from the proposal site obtained from City of Bellingham's Urban Streams Monitoring Report, 2011.

	Temperature	Dissolved Oxygen	Fecal Coliform	Turbidity
Bakerview Avg	8.5	10.1mg/L	62 CFU/100mL	7.2 NTU
Meridian Avg	9.7	10.4 mg/L	53 CFU/100mL	9.8 NTU
Bakerview Max	~15.5	N/A	>1000 CFU/100mL	13.6 NTU
Meridian Max	~16	N/A	>1000 CFU/100mL	19.9 NTU
Bakerview Min	N/A	~6.0 mg/L	N/A	1.2 NTU
Meridian Min	N/A	~7.0 mg/L	N/A	2.6 NTU
Ideal for Salmon*	9-12 °C	9 mg/L	<50 CFU/100mL	Minimal

*Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in Pacific Northwest and Alaska. EPA #910/9-91-001. May, 1991.
CFU=Colony Forming Units

2.1.2 Proposed Action:

By rerouting the creek around Sunset Pond and modifying Bug Lake in-stream temperatures will be decreased. This is achieved by decreasing residence time of the water in the ponds, decreasing the stream width from an average of 375 feet in the ponds to 20 feet in the new channel, and increasing riparian width and shading. DO will likely be improved due to decreased thermal loading and improved riparian zones. In addition, the proposed re-route moves the stream away from an off-leash dog area near Sunset Pond that contributes fecal coliform. The presence of LWD and an increase in channel complexity will increase the stream's ability to withstand high and low flow conditions.

Possible adverse hydrological impacts of the proposed action include the transport of sediments from the newly created stream channel (see Section 2.1), which could result in increased water temperature and decreased water quality. Construction activities related to the re-route will also have the potential to impact the hydrology of the site. Construction will take place entirely within wetlands and waterbodies, so any construction-related spill or discharge will have the potential to directly contaminate Squalicum Creek and related hydrology. Additionally, Squalicum Creek Floodplain Management Plan field reconnaissance studies in 1994 suggested that Bug Lake and Sunset Pond contribute to positive water quality function by decreasing turbidity, fecal coliform concentrations and total phosphorus during high flows. By filling in Bug Lake and routing the creek around Sunset Pond, this function during storm conditions will be lost.

The proposed action will continue to receive stormwater runoff from surrounding industrial, residential and agricultural areas and may be at risk of receiving more contaminants in the case of future

development. The new creek route brings it in close proximity to the proposed Orchard Street extension which will provide greater access to the nearby hospital and take pressure off of James Street (Figure 4). Additionally, along this same stretch the creek passes under I-5, leaving little space for an adequate riparian zone that would help filter road runoff.

North of Bug Lake, a piece of industrially zoned property is poised for future development as part of the existing health care complexes. This development has been permitted and approved to move forward. This development, along with the Orchard Street extension discussed above, will increase impervious surfaces adjacent to the proposed creek channels. While habitat improvements will hopefully attract higher populations of native salmonids and other species, an increase in stormwater runoff from impervious surfaces may expose these and other species to increased metal and oil pollution.

Wetlands and more robust riparian zones created by the project are expected to provide a buffer for the creek and to filter out some of the contaminants. However, constructed wetlands do not always function as well as natural wetlands or as expected. Additionally, nutrient removal by wetlands takes place mostly during the growing season and cold spells can cause die backs that will release nutrients back into the system. Agricultural, recreational and industrial land uses adjacent to and upstream from the project site have the potential to contribute to nutrient loading, which may overload the wetlands and reduce their ability to maintain adequate water quality.

Mitigation

During construction, a vehicle staging area will be set up 100 feet or more from any stream, waterbody or wetland. Vehicle staging, cleaning, maintenance, refueling and fuel storage will take place in this staging area to avoid contamination of the sensitive streams and wetlands. A spill containment and control plan will be put in place with notification procedures, specific cleanup and disposal instructions for all products that will be in use during construction. Personnel will be trained in methods of spill containment and disposal of spilled materials. Construction mitigation will be required under the NPDES construction permit acquired from the Washington Department of Ecology.

All vehicles will be inspected daily for fluid leaks prior to leaving the staging area, and any leaks detected will be repaired before operation resumes. All equipment will be pressure washed to remove any sediment, oil, grease, and other visible contaminants before beginning operations and whenever else necessary.

After project completion, education and volunteer opportunities will be provided to promote stewardship and understanding of surrounding land use impacts on streams. Education will foster more preventative action and help citizens to make informed choices about contributing to nonpoint source pollution.

The loss of positive water quality impacts of the lakes will be mitigated by improvements to the stream channel, which will increase channel complexity and support robust riparian zones. These improvements in the stream channel will also improve natural sediment transport and retention. Greater floodplain connectivity and the overflow channels into Bug Lake will help mitigate high flow impacts and reduce flooding potential.

Continuous long-term water quality monitoring following completion of the project will allow managers to evaluate the effectiveness of natural filtration in improving water quality. Adaptive management strategies will be followed, allowing management plans to be updated and improved based on monitoring data. Current water quality and stormwater data collected by the City of Bellingham (COB) for the establishment of TMDLs will provide a baseline for comparison.

2.1.3 Alternative Action:

Narrowing the stream channel through Bug Lake and Sunset Pond will ultimately lead to decreased water temperatures and increased DO due to increased wetlands and riparian zones. Filling in the ponds will also create more of a buffer between the dog park and the creek, reducing fecal coliform levels.

As the ponds are filled in, the water temperature in the creek will likely increase temporarily due to sediment loading, as discussed in Section 2.1. Runoff and pollutants from roads and industrial zones will continue to be an issue for the creek system. However, wetlands and riparian areas constructed in this alternative will likely be less functional than the proposed action because a more natural stream bed with floodplain will encourage the development of natural wetlands as opposed to entirely constructed wetlands around the current constructed channel.

Sunset Pond is estimated to provide about 20 acre/feet of flood storage in its current state (GeoEngineers 2002). By filling this in, a significant flood mitigation mechanism is removed. This alternative could result in increased flood risk in the valley that has the potential to damage surrounding development and infrastructure.

Mitigation

Temporary adverse impacts will be mitigated by improved stream channel complexity and increased wetlands and riparian coverage. Adaptive management of the wetlands and in-stream water quality will allow managers to monitor the effectiveness of natural filtration. Education and volunteer opportunities will help educate the surrounding community about water quality issues and practices to contaminant inputs to runoff. Construction mitigation will be required under the NPDES permit acquired by the Washington Department of Ecology.

Flood impacts will be mitigated by increased wetland and riparian areas as well as maintaining overflow pathways downstream under Squalicum Parkway and vegetated areas south of Bug Lake.

2.1.4 No-Action Alternative:

If no action is taken, water quality issues are not expected to resolve themselves and will continue to be an issue for the creek. High water temperatures and low DO will continue to limit habitat suitability for salmon, and populations may continue to decrease. Runoff from industrial centers and fecal coliform from pasture land and dog parks near Bug Lake and Sunset Pond will continue to contribute to water pollution. Any future development or worsening in stormwater contents will likely have an impact on the water quality characteristics of the stream.

Mitigation

Continued monitoring by the COB will allow managers to track water quality problems but will not fix current or future problems.

2.2 Earth

This section will describe current soil conditions and significant impacts from each alternative action including mitigation measures to reduce impacts.

2.2.1 Existing Conditions

Squalicum Creek runs through a glacial floodplain in a shallow valley. The valley walls rise approximately 60 feet from the valley floor, with a steeper slope on the south wall and gradual slope on the north wall, but the stream restoration will all take place within the existing flat floodplain. The soils are generally glacial till and silt. The valley floor is primarily made up of Group D hydrologic soils, which have very slow infiltration rates and high runoff and erosion potential. Along the southern valley wall group C soils dominate, with moderate to slow infiltration rates and moderate runoff and erosion potential. In these soils there is a surface layer of fine-grained glacial outwash, underlain by a layer of coarse gravel. There is a noticeable 2-foot layer of clay in the stream's bank.

Erosion has been identified in multiple locations along Squalicum Creek, with the potential to reduce stream wall stability and increase sedimentation. This has been a particular issue along the BNRR (Burlington Northern Railroad) grade. Impounded flow and buildup of sediment has redirected stream flow and caused erosion of the BNRR grade prior to the creek entering Sunset Pond; the bank is currently being maintained with riprap. Maintenance of this grade restricts the growth of a healthy riparian zone on this bank of the creek and creek migration. Approximately 17% of the project reach contains soils with a severe risk of erosion by water.

A sizeable delta has also formed at the inlet to Sunset Pond, where bedload sediments are being deposited. Sunset Pond, and to a lesser degree, Bug Lake act as sediment sinks. The ponds prohibit sediments from the upper watershed from continuing through the remainder of the Squalicum Creek system. These sediments include the cobbles and gravels which are vital to providing suitable salmonid spawning grounds and ideal habitat for benthic invertebrates. The lower reaches of the creek, downstream from Sunset Pond and Bug Lake, are deficient in these types of sediments.

Summary by Map Unit — Whatcom County Area, Washington (WA673)

Map unit symbol	Map unit name	Rating
11	Bellingham silty clay loam, 0 to 2 percent slopes	Fine, mixed, nonacid, mesic Typic Epiaquepts
82	Kickerville-Urban land complex, 0 to 3 percent slopes	Coarse-loamy, isotic, mesic Typic Haplorthods
108	Nati loam, 5 to 15 percent slopes	Coarse-loamy, isotic, mesic Typic Haplorthods
172	Urban land-Whatcom-Labounty complex, 0 to 8 percent slopes	
178	Whatcom silt loam, 0 to 3 percent slopes	Fine-loamy, isotic, mesic Aqualfic Haplorthods
179	Whatcom silt loam, 3 to 8 percent slopes	Fine-loamy, isotic, mesic Aqualfic Haplorthods
180	Whatcom silt loam, 8 to 15 percent slopes	Fine-loamy, isotic, mesic Aqualfic Haplorthods
181	Whatcom silt loam, 30 to 60 percent slopes	Fine-loamy, isotic, mesic Aqualfic Haplorthods
193	Water	

Figure 8. Soil Map of proposal site.

Porous fill under the I-5 and James Street culverts allows subsurface flow during low flow periods, which restricts passage of fish species.

2.2.2 Proposed Action:

Soil erosion will be a significant issue during construction. The creation of the new stream channel will require clearing of vegetation in the path of the new channel, as well as excavation and grading of the channel. During this period of channel creation soil will be exposed to potential erosion by wind, rain or other weather conditions. Soil compaction may also occur as a result of traffic by construction vehicles.

Following channel construction, short-term increases in suspended sediments are likely, as unconsolidated sediment in the new stream channel is flushed out by the streamflow, and sediment that would normally accumulate in Bug Lake is instead transported out of the system by the stream. Long-term sediment processes are expected to revert to those typical of a functioning riparian system. Erosion and channelization as a result of stream activity may occur in the new stream channel. Following the re-route of the creek, the former channel will also have a high potential for soil erosion in the period of time after the water is routed out of the channel and before new vegetative cover is established in the creek bed.

The filling of Sunset Pond has the potential to increase sediment loading, which could have a significant effect on turbidity, DO and water temperatures. These changes will have the potential to negatively affect benthic invertebrates and salmonids in and around the pond during construction and for several months after.

Mitigation

Erosion control will be carefully implemented throughout all stages of construction. All exposed soils will be protected from erosion by mulching, plastic sheeting, hydroseed covering, or other approved measures within one week of grading during the dry season (May 1-September 30) and within two days during the wet season (October 1-April 30). Wind-blown dust from the site will also be minimized and controlled during construction using appropriate methods such as water application to dry soils. Materials for emergency erosion control will be onsite during construction, including sediment control materials, such as straw bales and dirt bags. The creek will not be routed through the new channel until the channel is complete. Gradual re-routing will also help mitigate increased sediment loading and turbidity. In-stream turbidity will be monitored during rerouting, and erosion controls will be inspected daily to ensure that they are working adequately.

To minimize disturbance to the areas adjacent to the construction site, boundaries for the clearing limits will be flagged in the field prior to construction, and during construction no disturbance will be allowed beyond the flagged limits. Sediment and sediment laden water will not be allowed to enter the drainage system or roadways. Sediment-laden water collected during construction will be pumped to an infiltration area away from the creek and other sensitive areas. All temporary erosion and sedimentation control measures will be removed within 30 days after final site stabilization is achieved. Disturbed soil areas resulting from removal will be permanently stabilized.

Fill materials for Sunset Pond will be sourced entirely from the excavation of the new creek bed, reducing the risks associated with importing sediments from other environments. Construction will take place outside of salmon spawning season so that sediments will have time to settle before salmon enter the creek for spawning. Complexity in the new channel will add to sediment retention and creation of

healthy spawning habitat. The former creek bed will be revegetated as soon as feasible following the re-route of the creek, reducing the potential for soil erosion.

Since this project will involve excavation that would impact over one acre of land, operators or the site are required to obtain a NPDES General Construction Permit from the Department of Ecology. In order to acquire this permit, supervisors must develop a plan to prevent stormwater pollution, sediment pollution, and erosion into the local water bodies. This permit requires turbidity sampling once every calendar week after the soil has been disturbed. If a sample comes back with a turbidity rating higher than 250 NTUs, then the construction operators must inform the DOE within 24 hours and begin sampling daily. The permittee is also required to adopt and regularly monitor the Best Management Practices (BMPs) designed by the DOE to prevent runoff from entering either waters of the state or public storm water facilities.

2.2.3 Alternative Action:

Because this alternative does not require the creation of a new stream channel, erosional effects on soil are expected to be less significant than in the proposed action. During the process of filling the ponds, an increase in sediment loading is expected to have a significant effect on turbidity and water temperatures. These changes will have the potential to negatively impact salmon and benthic invertebrates during construction and for some months after.

Mitigation

Fill material for the ponds will be locally sourced and will be carefully chosen so as to match the soil type and texture of existing area soils. Erosion control measures will be put in place along roadsides and the railroad grade to reduce the potential of erosion compromising bank stability. The stream will be allowed to meander within the wetland mosaic created in the existing ponds, reducing the potential for issues related to channelization and bank erosion. Fill will be added gradually starting in low flow areas of the ponds. In-stream turbidity will be monitored to avoid excessive sediment loading and loss of fill material downstream.

Since this project will involve excavation that would impact over one acre of land, operators or the site are required to obtain a NPDES General Construction Permit from the Department of Ecology. In order to acquire this permit, supervisors must develop a plan to prevent stormwater pollution, sediment pollution, and erosion into the local water bodies. This permit requires turbidity sampling once every calendar week after the soil has been disturbed. If a sample comes back with a turbidity rating higher than 250 NTUs, then the construction operators must inform the DOE within 24 hours and begin sampling daily. The permittee is also required to adopt and regularly monitor the Best Management Practices (BMPs) designed by the DOE to prevent runoff from entering either waters of the state or public storm water facilities.

2.2.4 No-Action Alternative

There will be no significant change to the soil and earth on the site. Erosion will continue on stream banks, along the railroad grade and following flow-restricting culverts, where the water velocity increases. Bug Lake and Sunset Pond will continue to restrict sediment movement downstream.

2.3 Animals

This section will describe species of concern within the creek and significant impacts to habitat and passage and predation from each alternative action including mitigation measures to reduce impacts.

Note: While salmon are themselves a predatory fish, since the main objective of this project is to improve salmon survival, the term* predatory fish *here refers to warm-water fish species that prey on native salmon in Squalicum Creek.

2.3.1 Species of Concern

Riparian areas function as wildlife corridors for a variety of birds and mammals and provide crucial habitat for riparian-dependent species. Transportation corridors, including I-5, James Street and Squalicum Parkway, currently serve as barriers to animal movement. Historically, the watershed provided habitat for coho salmon, chum salmon, cutthroat trout, and sea-run steelhead. Bull trout have been observed in the lower reaches of the creek and are presumed to occur throughout the watershed. Chinook salmon have also been observed in Squalicum Creek, although they are likely strays from the nearby Nooksack River watershed. The Puget Sound populations of bull trout, chinook salmon, and steelhead salmon are listed as threatened under the Endangered Species Act.

In addition, both coastrange and prickly sculpin, native non-game fish species which can be important food sources for juvenile salmon, are present in the lower reaches of Squalicum Creek. Other native fish species that utilize Squalicum Creek are the three-spine stickle back and the Pacific and western brook lamprey.

Aquatic macroinvertebrates are often used as indicators of stream health and water quality because of their sensitivity to pollution and other parameters. Salmon also feed on macroinvertebrates, making them an essential part of the aquatic food chain. A 2000 assessment of Squalicum Creek's macroinvertebrate communities found that all sample sites--including Bug Lake--had low numbers of pollution-sensitive species and were dominated by pollution-tolerant species, indicating that the creek's water quality has an adverse effect on macroinvertebrates and consequently on native salmon populations.

Additional species which have been identified on this site include an abundance of garter snakes, lizards, nonurban mammals and birds, salamanders, newts, and frogs. Signs of beaver activity were reported above Sunset Pond and below Bug Lake in a 2002 Nooksack Salmon Enhancement Association (NSEA) study, indicating that beavers could utilize the project area and may play a role in hydrologic processes. High-quality salmon spawning habitat is often found directly downstream of beaver dams, so allowing beavers to utilize the project area could result in an increase in spawning habitat created by the proposed action.

2.3.2 Fish Habitat

This section will describe habitat in the creek and significant impacts of each alternative action including mitigation measures to reduce impacts.

2.3.2.1 Existing Conditions

Historic channel modification has limited salmon habitat along the reach of the creek. Pacific Northwest salmon species require high levels of dissolved oxygen and consequently relatively low water

temperatures, low turbidity, and high water quality. Spawning areas require gravel beds within active stream channels in order to keep eggs aerated during incubation. Suitable spawning habitat exists in some less modified areas of the project area that contain gravel pockets, while other stretches have been straightened and had their in-stream habitat structures removed. Spawning and rearing habitat for salmon in such areas is poor. Sediment supply, storage and transportation have been altered by land use practices retention in the ponds, making appropriate spawning habitat very rare in the stream channel.

In addition, mature salmon traveling upstream to spawn require in-channel pools to rest and at times to hold until spawning commences. Rearing habitat for salmon consists of side-channel habitat, particularly for coho salmon, and pools for young fish to rest, gain protection from predators, and access cooler water temperatures during the summer months. Pools adjacent to riffles allow juveniles to use pools as resting areas but still access food in faster water.

The lack of channel complexity caused by low LWD and substrate recruitment creates a shortage of habitat in many stretches of Squalicum Creek. For example, the stream channel between James Street and I-5 has been straightened as a result of industrial development and lacks stream complexity and sediment retention required for proper spawning and rearing habitat. Downstream of the I-5 culverts, spawning habitat is of higher quality due to the fact that the stream is allowed to meander and maintains some complexity.

Bug Lake and Sunset Pond both contribute to salmon habitat reduction in Squalicum Creek. These shallow ponds have increased water temperatures and low DO levels during the summer months, reducing habitat suitability for salmon species such as pink, coho, chum, steelhead, and cutthroat trout. The ponds also have significant periods of elevated turbidity, as illustrated in Figure 8. Suitable habitat for juvenile rearing is within a 10-foot band around the perimeter of Bug Lake and a 6-foot band around the perimeter of Sunset Pond (Figure 8) These values are based on the slopes of the ponds and the Washington Department of Fish and Wildlife (WDFW) depth suitability index for coho salmon.

Figure 9. Bug Lake; note shallow water and silty substrate

Some coho and chum do pass through Bug Lake, Sunset Pond and the I-5 culverts, but most of the spawning takes place downstream of Bug Lake. Coho and chum have also been seen spawning in Baker Creek, a tributary to Squalicum Creek, but not in Toad Creek, another tributary above Sunset Pond.

2.3.2.2 Proposed Action

Short-term sediment increases discussed in Sections 2.1 and 2.2 (above) could decrease the site's fish habitat quality on a short-term basis, because sediment increases will likely have the effect of raising water temperatures. Increases of water temperature are correlated with DO decreases, while Pacific Northwest salmon species require relatively high levels of DO to survive and reproduce. Construction

activities may disturb or temporarily displace some wildlife species such as small mammals, waterfowl, songbirds, and amphibians. Tributaries V and W will be connected to the creek under this alternative and functioning as spawning and rearing habitat for salmon.

Channel modifications through Bug Lake and the new meandering channel constructed around Sunset Pond will improve sediment transport and retention throughout the system resulting in more rearing and spawning habitat.

Mitigation
Long-term benefits to fish habitat that are expected to result from the proposed action should mitigate the short-term impacts to water quality and the area's salmonid populations. Improvements to the stream channel as a result of the proposed action, such as adding LWD and riparian vegetation, will provide resting spaces and spawning habitat for native salmonid species. At least three backwater side-channels, which are critical components of coho salmon habitat, are planned for the new channel between I-5 and James Street.

Construction activities are not expected to impact any threatened or endangered mammal, waterfowl, songbird, or amphibian species. Construction will also be limited to a relatively small spatial scale, since the stream and water bodies are generally less than 200 feet wide throughout the area, so construction should have a minimal effect on non-fish species. Construction is also expected to proceed in distinct phases, so the spatial area affected by active construction at any given time is likely to be small enough that animal species can move to other areas without significant detrimental impacts.

2.3.2.3 Alternative Action

This alternative will not improve channel habitat in areas of the stream that were straightened during the construction of I-5, which lack LWD that provide habitat and resting space for salmonids.

Mitigation
Tributaries W could be extended to become connected with the existing stream channel, providing upstream habitat for native fish in unmodified channels. The addition of LWD in the creek between the ponds is recommended to increase channel complexity, create resting spaces and provide spawning areas by facilitating sediment retention.

2.3.2.4 No-Action Alternative

If no action is taken on the creek, salmon spawning and rearing habitat will not be improved. Levels of salmon in the creek, which have been declining for many years, will continue to decline.

2.3.3 Fish Passage

This section will address fish passage issues in the creek and significant impacts of each alternative action including mitigation measures to reduce impacts.

2.3.3.1 Existing Conditions

A WDFW study conducted in 1998 estimated that the entire Squalicum Creek watershed contains 84 km (52 miles) of suitable salmon habitat but that the upper 12 km (7.4 miles) of spawning and rearing habitat is inaccessible to the vast majority of the creek's native fish populations. Historical fish sightings demonstrate that the majority of spawning currently occurs downstream of Bug Lake. This suggests that upstream barriers are restricting spawning territory.

In addition to the predation and competition issues created by Sunset Pond and Bug Lake, a number of fish passage barriers restrict the movement of adult salmon moving toward spawning grounds. These include culverts such as those under I-5, which are too narrow and constrict the stream, increasing the velocity of the water moving through them. Culverts do not completely block passage but do result in decreased numbers of fish reaching upstream habitat. Water passing under I-5 forms a salmon barrier approximately 66% of the time, making it more difficult for adult fish to reach upstream habitat.

WDFW estimates that the maximum velocities for fish passage are 2.0 feet per second (fps) for adult trout and 3.0 fps for adult coho, chinook, sockeye and steelhead (1999). This occurs with stream discharges above approximately 20 cubic feet per second (cfs). Table 2 shows the stream velocity before and after the I-5 culverts at various stream discharges as modeled by GeoEngineers (2002) and actual measured discharges from Squalicum Creek from 2001-2002 are shown in table 3. Both tables demonstrate the high potential of the I-5 culverts to exceed WDFW's recommended velocities and restrict fish passage when velocities are in excess of 3 fps. It can be concluded that observed conditions likely produce velocities that are too high for salmon passage through culverts and in-stream structures.

In addition to salmonids, native sculpin species are also important to the function and health of Squalicum Creek. Since sculpin species are weak swimmers and generally require velocities of less than 1 m/s to travel through in-stream structures, current discharges likely impair the upstream passage of these species as well.

Table 4 presents a list of potential barriers to fish passage and the conditions in which they are most likely to have an impact. It should be noted that the City of Bellingham has modified the Bug Lake outlet culverts (first row, Table 4) and improved them for fish passage.

Table 2. Modeled velocities in the I-5 culverts from Squalicum Creek Re-Route Feasibility Study (GeoEngineers, 2002). Note that shaded areas exceed WDFW's maximum fish passage velocities for salmon

Squalicum Creek Dischage (cfs)	Discharge in each Culvert (cfs)	Velocity at Inlet (fps)	Velocity at Outlet (fps)
5.0	2.5	1.37	1.66
10.0	5.0	1.67	2.26
15.0	7.5	1.92	2.73
20.0	10.0	2.10	3.22
25.0	12.5	2.26	3.76
30.0	15.0	2.39	4.21
35.0	17.5	2.52	4.54
50.0	25.0	2.83	5.04
70.0	37.5	3.23	5.37
100.0	50.0	3.55	5.68

Table 3. Squalicum Creek Discharges Measured by NSEA from November 2001-February 2002. Note the wide range of discharge values even within relatively short periods of time, and shaded values indicating discharges in exceedance of WDFW maximum velocities for fish

DATE	DISCHARGE (cfs)
11/01/2001	15.38
11/06/2001	16.75
11/11/2001	1.89
11/16/2001	34.09
01/31/2002	66.99
02/07/2002	40.26
02/21/2002	67.06
02/28/2002	25.49

Table 4. Potential upstream barriers to fish passage in the study area from Squalicum Creek Re-Route Feasibility Study (GeoEngineers, 2002).

BARRIER	OCCURRENCE	CONDITION	PASSAGE
Culvert at Bug Lake outlet	Low Flows	Subsurface Flow	Impassable
Stream channel upstream of Bug Lake	All flows	High velocity in chute formed in clay outcrop	Passable
I-5 culvert; 225 feet long	Mid and higher flow	High velocity	Impassable
Stream channel upstream of I-5 culvert	High flow	Velocity and no resting stations after I-5 culvert	Passable
Sunset outlet	Low flow	Subsurface flow	Impassable

The channel upstream of the I-5 culverts has been straightened from its natural meandering state, while boulders and LWD have been removed for a 560-foot length to the James Street culvert. These modifications have eliminated the stream complexity that under natural conditions would provide resting places for fish. Upstream of James Street, LWD has allowed pools and riffles to develop; however, porous quarry spalls armoring a storm sewer pipe causes the stream to revert to subsurface flows during low flow periods.

Another barrier to fish passage is a clay chute caused by erosion of a portion of the stream channel upstream of Bug Lake. At high flows the stream passes through the chute and spreads out over the

surface of the clay bench, forming a shallow sheet flow that likely serves as a partial barrier to fish, decreasing the number of fish that are able to successfully make their way upstream. Additionally, porous fill that was placed under the James Street culverts allows subsurface flow, which further restricts fish passage during low flow periods.

None of the individual impediments along the stream channel completely block fish passage, but each of them has potential to impede passage at certain flows. Currently, partial or total blockage to fish passage exists at all flow levels (low, mid, and high), making it difficult for the Squalicum Creek system to support viable populations of salmon species.

2.3.3.2 Proposed Action

During in-channel construction, fish barriers will be installed upstream and downstream of construction areas in order to prevent fish from entering the construction site. However, this would prevent the movement of fish through the watershed, particularly in the spring, summer and fall as any mature salmon attempt to move upstream to their spawning grounds.

Mitigation

During in-channel construction work, fish rescue--the act of removing fish from the channel and transporting them to suitable release areas upstream or downstream--will be carried out in order to minimize the chance of fish becoming stranded in the channel as it is de-watered, particularly in the existing channel between Sunset Pond and Bug Lake. Fish rescue will be carried out by Washington Conservation Corps crews and supervised by a trained fisheries/aquatic biologist.

The culverts passing under Squalicum Parkway have been improved by the City of Bellingham to improve fish passage. Under the proposed action, grade control riffles--a roughened channel constructed from large stones designed to emulate bedrock and create a more gradual transition across changes in slopes or water elevation--will be installed at the James Street underpass and improve fish passage through the eastern portion of the proposed channel re-route. A conveyance structure underneath I-5 will be constructed as part of a separate project and could improve fish passage if designed to maintain channel complexity, substrate continuity, and slow high velocities through such structures as baffles or grade control riffles. Because the conveyance structure's design is unknown, its impact may not be fully mitigated. Culvert modifications as part of the proposed action will reduce stream velocity and disrupted flow patterns and improve fish passage.

2.3.3.3 Alternative Action

The alternative action retains the route of the existing channel and will still impede fish passage due to the barriers identified in Table 4, some of which are completely impassable to fish under certain conditions, and some of which impede but do not exclude fish passage.

Mitigation

Passage barriers caused by the clay chute could be mitigated by adding substrate to the stream channel in order to slow the stream's velocity and increase the channel's resistance to erosion and weathering. The channel could also be widened slightly in this area to slow velocity and promote more intermediate and stable flows. Care must be taken, however, to ensure that the channel is not made too wide and shallow so that thermal loading does not occur. This alternative retains the original I-5 culverts, which could be improved to maximize fish passage during periods of mid and high flow by reducing the stream's velocity through culvert baffles or grade control riffles. The channel upstream of the I-5 culverts could be improved for salmon habitat through the addition of large substrate and LWD to increase channel complexity and create holding pools for fish. Finally, while the Sunset Pond outlet

could still experience low flows, the presence of an active channel within the pond will decrease the potential for subsurface flow conditions.

2.3.3.4 No-Action Alternative

If no action is taken, culverts and other obstacles will continue to serve as partial to complete barriers to fish passage in high-flow and low-flow conditions. These passage barriers will continue to limit the number of salmon able to reach spawning grounds in the upper reaches of the creek.

2.3.4 Predation

This section will address issues related to the predation of juvenile salmon in this stretch of Squalicum Creek.

2.3.4.1 Existing Conditions

Bug Lake and Sunset Pond both contribute to fish predation in Squalicum Creek. A 2002 study by NSEA found six species of warmwater fish in the project area: brown trout, largemouth bass, yellow perch, bluegill, brown bullhead, and yellow bullhead. These non-native fish may have a competitive advantage over the native salmonids, as they can withstand warmer water and lower DO, both of which are found in Sunset Pond and Bug Lake. These species are also piscivorous (fish-eating), and prey on juvenile salmonids in the ponds and creek, and some may compete with salmon for spawning and rearing habitat. A 1998 survey of the Sunset Pond fish community found that it was dominated by warmwater species, especially young largemouth bass and mature yellow perch.

2.3.4.2 Proposed Action

Under the proposed action, the re-routed stream channel will still maintain a high-flow spillway with Sunset Pond, which could allow non-native and native fish species to occasionally come into contact with one another. If high flows occur during seasons in which juvenile salmon are present in the system, predation by mature warm-water fish species is possible. Warmwater fish could potentially be re-introduced by the public or angling community further upstream of the project area and re-colonize the ponds.

Mitigation

The proposed action will decrease the potential for predation of native fish by introduced warm-water species through the spatial separation of the two groups and decreased habitat for non-native fish. By routing around Bug Lake and creating a proper stream channel in Sunset Pond, habitat for native fish will improve and lessen the chances of juvenile salmon being present in Sunset Pond or Bug Lake. The proposed action will restrict warmwater fish to Sunset Pond, with limited access to the re-routed channel and juvenile salmon rearing habitats and migration routes. As habitat for predatory fish species is reduced through the creation of active stream channels and wetlands in Bug Lake and Sunset Pond, their populations should decrease and reduce the potential for predation on juvenile salmon. Increased education and public outreach on the predation impacts of introduced warmwater fish species on native fish populations could reduce the potential for the reintroduction of predatory species.

2.3.4.3 Alternative Action

The alternative action would not decrease the potential for predation on salmon by warmwater fish species because it maintains the creek's current course into Sunset Pond. For native salmon to leave the system as juveniles and begin migrating to marine systems, the only available route travels through Sunset Pond and Bug Lake, exposing them to the risk of predation. Warmwater fish could potentially be re-introduced by the public or angling community further upstream of the project area and re-colonize the ponds.

Mitigation

If Tributaries V and W are connected with the main stream channel, salmon could utilize the tributaries for spawning and rearing, but would still be required to pass through Sunset Pond and Bug Lake as they out-migrate, so the predation impacts of the alternative cannot be fully mitigated. However, native fish species could be benefited by the reduction of predatory fish habitat that would occur through filling in the ponds, and increased channel complexity would provide greater protection for juvenile salmon than is currently available. Increased education and public outreach on the predation impacts of introduced warmwater fish species on native fish populations could reduce the potential for the reintroduction of predatory species.

2.3.4.4 No-Action Alternative

Bug Lake and Sunset Pond will continue to support species predatory to native salmonids. This will continue to limit the number of juveniles able to survive to maturity in the Squalicum Creek system.

2.4 Wetlands

This section will describe the extent of current wetland areas and significant impacts from each alternative action including mitigation measures to reduce impacts.

2.4.1 Existing Conditions

The current stream channel is bordered by a small patch of wetland delineated by the Fish and Wildlife National Wetlands Inventory (NWI) and passes through an area of wetland identified by COB in their 1992 wetland inventory (Figure 9). A wetland mitigation site from another project is also located between Sunset Pond and Bug Lake and slightly to the north.

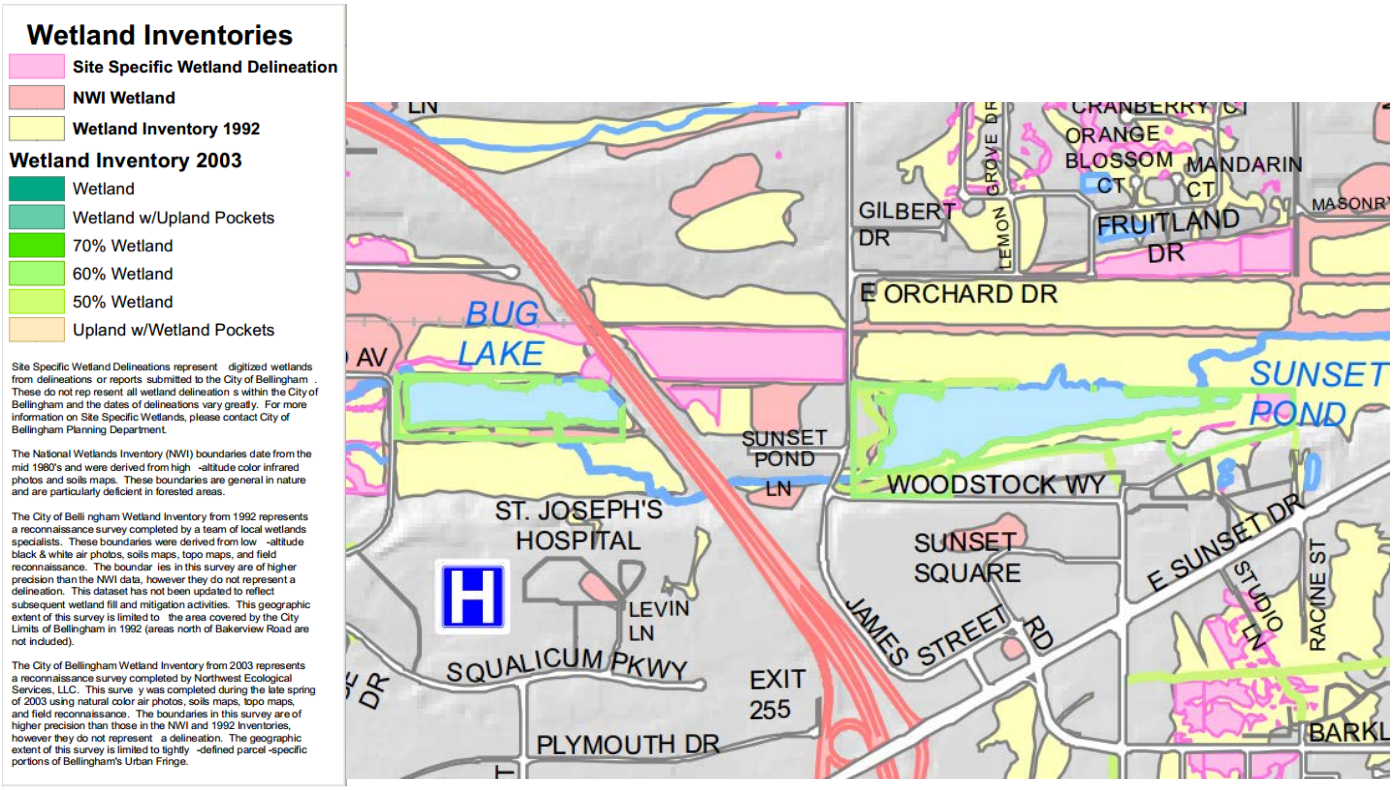

Figure 10. Images from Bellingham Wetland Inventory Map showing detail of the area around Sunset Pond and Bug Lake and the location of the new proposed stream.

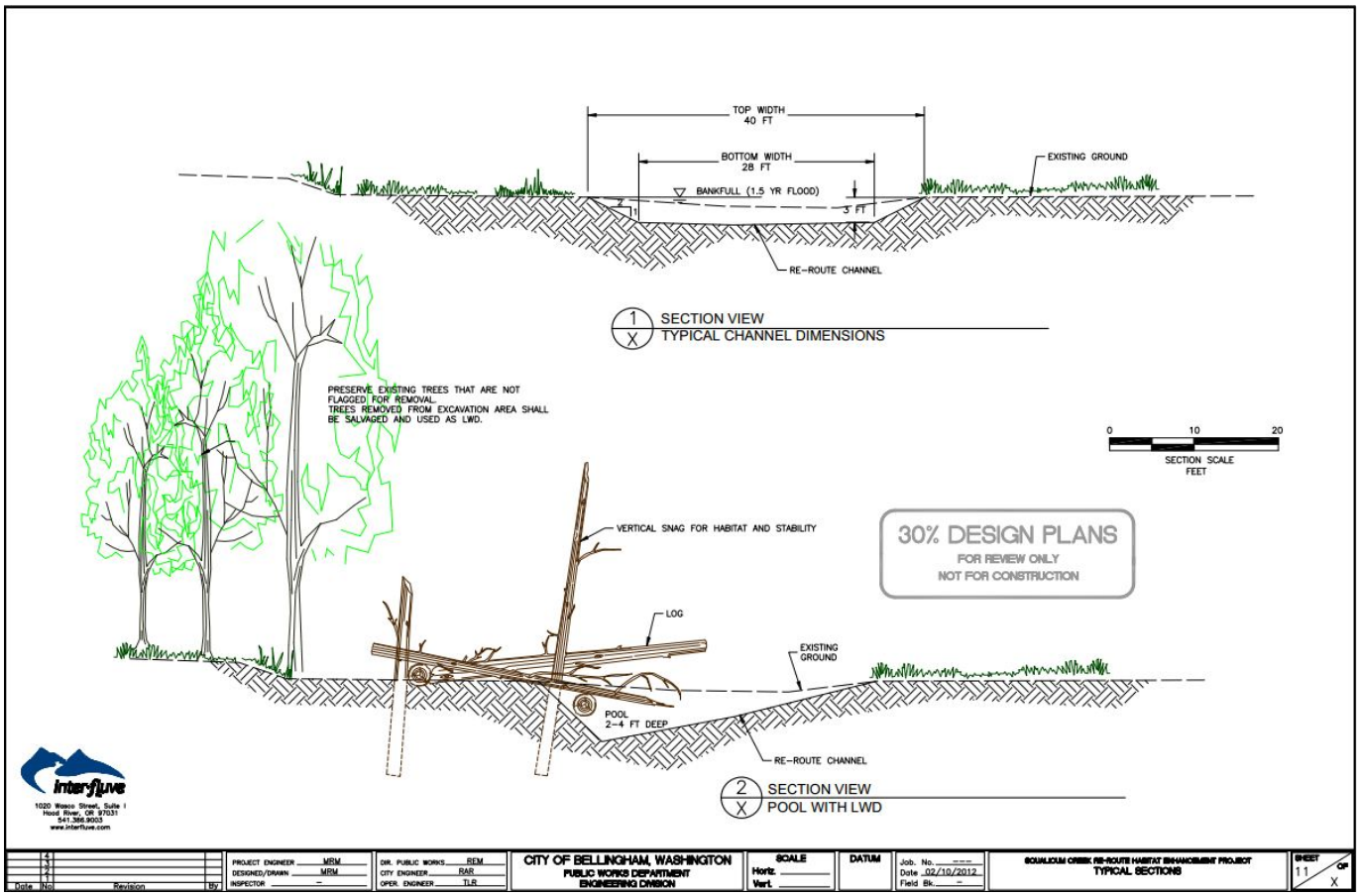

Figure 11. Wetland and channel design plans. Source: COB

2.4.2 Proposed Action

The proposed action routes the new stream channel through wetlands identified by Site Specific Wetland Delineation by COB and 1992 Wetland Inventory wetland. Subsequent fill and mitigation activities are not reflected in the 1992 data. The new stream channel between Sunset Pond and Bug lake will take advantage of the existing wetland mitigation site as riparian area and floodplain. Portions of these wetlands will inevitably be disturbed by excavation and machinery. Additionally, floodplain area will allow for stream migration that will wash out sections of wetlands at various times. This floodplain, migrating stream, wetland system will be designed to function on its own as an adaptable and resilient environment as natural stream processes dominate, contributing to wetland formation and function.

Additional wetland areas will be constructed in the filled in portions of Bug Lake. This will expand upon the 60% wetland areas identified in the COB 2003 Wetland Inventory.
Constructed wetlands may, but do not always function like natural wetlands. The newly constructed wetlands may not provide as much habitat or demonstrate the productivity expected from them.

Mitigation
Construction activities will be constructed to designated areas to prevent excessive damage to surrounding vegetation. Adaptive management will be employed to monitor the reestablishment of

natural wetlands and riparian vegetation. Monitoring will also assess the functionality of the constructed wetlands and modifications may be made as deemed necessary.

2.4.3 Alternative Action

The alternative action includes the addition of riparian vegetation around the creek which will help encourage wetland areas adjacent to the existing stream bed. Wetland areas around the ponds will be expanded within the filled in lakes. Some existing wetland areas may be impacted during construction within the ponds by sediment input and machinery.

Mitigation

Impacts to existing wetlands will be kept to a minimum where possible. Constructed wetlands and increased planting will help establish more wetlands as a result of the project.

2.4.4 No-action Alternative

The conditions will remain the same as the existing conditions.

2.5 Plants

This section will describe current plant conditions and significant impacts from each alternative action including mitigation measures to reduce impacts.

2.5.1 Existing Conditions

The vegetation of the project site is primarily made up of mixed deciduous forest and wetland forest/shrub/emergent vegetation. 83% of this reach of Squalicum Creek is characterized by high-quality, diverse native habitat. Canopy cover is generally good along the length of the creek channel, but poor for Bug Lake and Sunset Pond. The site of the proposed channel is currently a densely wooded floodplain north of Sunset Pond. This area is filled with red alders, cedars, and low growing shrubs. Invasive species identified on the site include tansy ragwort, meadow knapweed, yellow flag iris, reed canary grass, Himalayan blackberry, hairy willow herb, and knotweed.

2.5.2 Proposed Action

It will be necessary for vegetation to be removed in the construction of the new channel, and some plants outside of the creek channel may be damaged in the construction process. In areas where plant cover is removed or damaged, invasive species will have the potential to spread into these areas, creating competition for immature native species and possibly restricting their establishment.

Mitigation

Any of the trees chopped down in construction of the new creek channel will be repurposed as LWD to form substrate and stream complexity within the channel. The eddies that form behind this debris will serve as excellent refuge for migrating salmon. New trees and other native vegetation will be planted along the channel immediately following channel completion. This will include fast-growing deciduous species, which will become established quickly and begin to increase channel shading. This will help to restrict the opportunity for non-native species to invade the area. Slower-growing coniferous trees will be interspersed with the faster-growing species, so that they eventually will have the opportunity to overtake the deciduous trees. Bug Lake and the filled section of Sunset Pond will be planted with a diversity of native wetland species.

2.5.3 Alternative Action

Plant impacts will not be as significant in this alternative as in the proposal, because this alternative does not require forest clearing to accommodate the formation of a new creek channel. Although no plants will be removed, some will inevitably be damaged by construction equipment or by the process of developing access points for construction workers to transport the fill material.

Mitigation

A diversity of native wetland plants will be added to the pond areas to create wetlands which will positively impact the stream habitat. The native plants brought to fill Sunset Pond and Bug Lake will outnumber the small number of those damaged during construction.

2.5.4 No-Action Alternative

No change will be made to the vegetation in the area.

2.6 Environmental Health

This section will describe environmental health conditions and significant impacts from each alternative action including mitigation measures to reduce impacts.

2.6.1 Existing Conditions

Land use within the project site is dominated by public/institutional and industrial zoned lands. Public lands are designated as Class A areas according to the Environmental Designation for Noise Abatement (EDNA) land use classifications. Industrial areas have a Class C EDNA. Maximum permissible environmental noise levels, as outlined in Washington Administrative Code (WAC) 173-60-040, are outlined in table 5. Noise levels within the site do not currently exceed these allowances.

Table 5. Maximum permissible environmental noise levels. WAC 173-60-040. Source: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-60-040.

EDNA OF NOISE SOURCE	EDNA OF RECEIVING PROPERTY		
	Class A	Class B	Class C
CLASS A	55 dBA	57 dBA	60 dBA
CLASS B	57	60	65
CLASS C	60	65	70

No toxic sites have been identified within the vicinity of the project; however, the proximity to industrial land use areas creates the potential for runoff of industrial materials and resulting pollution of the creek and associated soils. Industrial runoff may include metals, oils, and coolants, among other materials.

2.6.2 Proposed Action

During construction, vehicle cleaning, maintenance, refueling, and fuel storage will be important considerations for environmental health. Any fluid leaks from construction vehicles have the potential to negatively impact the project site. Noise during construction could also impact nearby residences and

public usage of the site. Construction noises will include the operation of trucks and other equipment during normal work hours (7-5), as well as dewatering pumps, which will run 24 hours per day during construction in the channel. Stormwater runoff from industrial and agricultural lands adjacent to the project site could have a negative impact on the environmental health of the site.

Mitigation
During construction, a vehicle staging area will be set up 100 feet or more from any stream, waterbody or wetland. Vehicle staging, cleaning, maintenance, refueling and fuel storage will take place in this staging area to avoid contamination of the sensitive streams and wetlands. A spill containment and control plan will be put in place with notification procedures, specific cleanup and disposal instructions for all products that will be in use during construction. Personnel will be trained in methods of spill containment and disposal of spilled materials.

All vehicles will be inspected daily for fluid leaks prior to leaving the staging area, and any leaks detected will be repaired before operation resumes. All equipment will be pressure washed to remove any sediment, oil, grease, and other visible contaminants before beginning operations and whenever else necessary.

The noise produced as a result of this project will be restricted to temporary construction noise and thus is exempt from EDNA standards. Despite this exemption, efforts will be made to keep noise disturbances at a minimum. Dewatering pumps will conform to local codes for noise standards. This will apply during in-channel work, which includes diverting Squalicum Creek from Sunset Pond to the re-route channel, opening the re-route channel to Bug Lake, dewatering Trib. W to the re-route channel, and plugging Trib W.

Following construction, contamination of the creek from runoff will be addressed and minimized by promoting awareness among residents and adjacent landowners. Education programs will teach watershed residents about the dangers of non-point source pollution to help in the prevention of future pollution.

2.6.3 Alternative Action
Environmental health will be affected in the form of short-term construction noise during normal business hours, which could impact nearby residences and public usage of the site. Construction-related issues, as discussed above, will also apply to this alternative.

Mitigation
As discussed in the proposal above, considerable care should be taken to monitor and consistently inspect construction vehicles to ensure that they will not input harmful discharges into the creek and wetland environment. Noise disturbances will be kept at a minimum by restricting construction to daytime hours.

2.6.4 No-Action Alternative
If no action is taken there will be no change to environmental health.

2.7 Aesthetics
This section will describe current aesthetic features and significant impacts from each alternative action including mitigation measures to reduce impacts.

2.7.1 Existing Conditions

Much of the project site is in a forested area, though industrial sites are also notable in the vicinity. A small park has been built on the west end of Sunset Pond off of James Street. This park has trails through the forested areas, as well as benches and picnic tables overlooking the pond. The pond and park are clean and well maintained. Bug Lake is less accessible to the public, though some City of Bellingham trails run along the north end of the lake. Algae blooms were noted in the lake near Squalicum Parkway, and at the outlet of the creek from Bug Lake, prior to entering the Squalicum Parkway culverts, litter and abandoned clothing was noted in and beside the creek. Most of the creek throughout the project site runs through wooded areas, though in sight of the Sunset industrial compound and I-5 in certain segments.

2.7.2 Proposed Action

The proposed re-route will significantly alter the site's aesthetics, particularly in the first years following the project's initiation. Sunset Pond will be altered from an open-water pond to a wetland, which may make the area less desirable for some visitors to the park and trails adjacent to the pond. However, the wetland habitat may attract additional visitors to the site, who have an appreciation of wetland environments. Following construction of the new creek route, aesthetics will initially be affected by the loss of vegetation cover alongside the creek channel. It will take several years for the new vegetation planted in the wetland areas and alongside the new creek channel to grow to ideal size and coverage.

Mitigation

To reduce negative aesthetics following construction, fast-growing deciduous species such as cottonwoods and alders will be planted along with slower-growing conifers along the bank of the stream. This will minimize the time it will take for the project site to become re-vegetated. Visually diverse, native wetland vegetation will be planted in the newly created wetland areas to maintain pleasing aesthetics of the area.

2.7.3 Alternative Action

This alternative will add riparian vegetation along the creek channel which will add to the aesthetics of the stream. Sunset Pond and Bug Lake will both be altered significantly. Both ponds will be partially filled, changing the appearance from open water to a wetland condition. While some visitors may be drawn in by the wetland habitats, others may be accustomed to the current condition of the ponds and may not be as receptive to the alteration in aesthetics. During the first several years following filling of the ponds, wetland vegetation will be growing and becoming established, and will not yet appear in its ideal state of health.

Mitigation

Mitigation will be the same as the proposed action. An effort will be made to educate visitors of the former lakes about the many benefits of wetland habitats and their superiority over open lakes in this situation. This will help visitors to recognize the value and beauty of the altered site.

2.7.4 No-Action Alternative

There will be no effect on the site's aesthetics.

2.8 Transportation

This section will describe current transportation features and significant impacts from each alternative action including mitigation measures to reduce impacts.

2.8.1 Existing Conditions

The project site is crossed by two arterial roads: Squalicum Way and James Street. I-5 also bisects the reach. Squalicum Creek passes under each of these roadways through culverts. Squalicum Creek is currently accessible by road at one point within the project site, at Sunset Pond off of James Street. Bug Lake is also accessible by walking trails. Public transit stops are located within .5 miles of either Bug Lake or Sunset Pond.

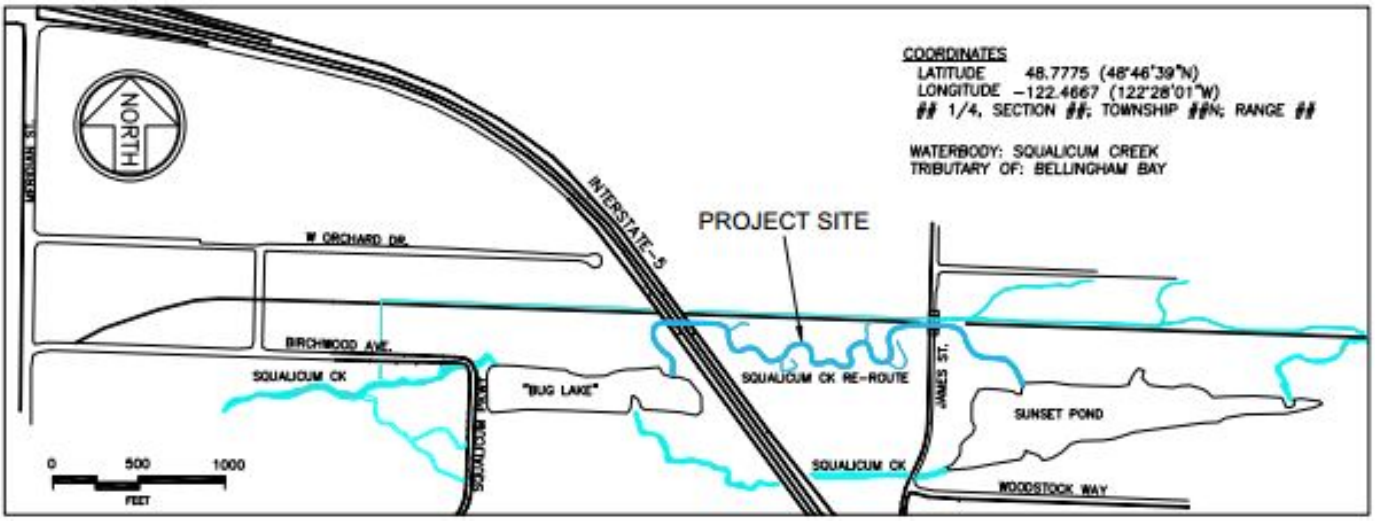

Figure 12. Project Site Map showing transportation corridors.

2.8.2 Proposed Action

The proposed action will require the building of two footbridges over the railroad grade, as well as the construction of a new James Street bridge. These improvements are being undertaken by different entities and are separate from this project; however, they will have an impact on this project, and thus will be included in the discussion. During construction of the James Street bridge, traffic will have to follow considerable detours, either by way of McLeod Road or Division Street and Hannegan Road. The building of the footbridges will not affect vehicle traffic, but may inconvenience individuals utilizing the trail. Trucks entering and exiting the road from construction zones has the potential to affect traffic throughout the duration of construction.

Following project completion, Sunset Pond and Bug Lake will remain accessible at the same points as previously, but the stretch of the creek between Sunset Pond and Bug Lake will be routed further from large roadways.

Mitigation

During bridge construction, traffic will be routed through the most convenient alternate route. Appropriate signage will be placed to alert drivers of the construction zone, and flaggers will be present to direct traffic and allow for movement of construction vehicles with the least possible traffic impacts. During construction of the stream channel, construction trucks and materials will be kept off of arterial

roadways, and soil and water from construction of the channel will be carefully collected and removed from the site so as not to negatively affect vehicle traffic.

2.8.2 Alternative Action

The transportation improvements, including the building of footbridges over the railroad grade and the construction of the new James Street bridge, will be undertaken regardless of whether the creek re-route goes through as proposed.

Mitigation

Mitigation for the alternative action will be the same as for the proposed action.

2.8.3 No-Action Alternative

The transportation improvements, including the building of footbridges over the railroad grade and the construction of the new James Street bridge, will be undertaken regardless of whether the creek re-route goes through as proposed.

2.9 Recreation

This section will describe current recreation opportunities and significant impacts from each alternative action including mitigation measures to reduce impacts.

2.9.1 Existing Conditions

Currently, Sunset Pond offers opportunity for recreation such as an off-leash dog area, walking, picnicking, and fishing. Several waterside trails and seating areas facilitate these activities (see Figure 12). There is a minor, unimproved walking trail to the north of Bug Lake, but no designated recreation amenities such as parking or picnic tables. Fishing is allowed at Bug Lake and is probably dominated by non-native warm-water species.

Figure 13. Well-trafficked recreational trail at Sunset Pond. Industrial buildings on James Street are visible in the background.

2.9.2 Proposed Action

Long-term angling of warmwater fish species will be reduced due to a decrease in habitat for those species through the creation of emergent wetlands and active channel in Bug Lake, and construction of emergent wetlands and deepening of Sunset Pond. It is likely that public access to areas of active construction will not be available, but this will occur on a relatively short-term timeframe (around 3-4 months). The proposed action could potentially require a modification to the route of the proposed Bay to Baker trail where the stream channel would intersect the trail.

Mitigation

Although Sunset Pond's overall area will be reduced, the constructed wetland area could still provide comparable recreation opportunities (walking, picnicking, etc.). Phase II of the project includes plans for a canoe/kayak trail through the constructed wetlands at the eastern end of Sunset Pond (see Figure 13 for conceptual image of similar trail). This will create a new recreation opportunity. In addition, over time the native salmonid fish populations may recover to the point that angling of those species will be a feasible option, further mitigating any loss of warm-water species. Any potential conflicts with the channel re-re-route and the proposed Bay to Baker trail could be mitigated by implementing one of several alternate designs of the trail route created by the City of Bellingham to avoid conflicts with other public projects in the vicinity. Adopting an alternate trail design will allow both the Bay to Baker trail and proposed action to proceed.

Figure 14. Conceptual image of canoe trail similar to the one in proposed action

2.9.3 Alternative Action

Under the alternative action, long-term angling of warmwater fish species will be reduced due to a decrease in habitat for those species through the creation of emergent wetlands and active channel in Bug Lake, and construction of emergent wetlands in Sunset Pond. It is likely that public access to areas of active construction will not be available, but this will occur on a relatively short-term timeframe (approximately 3-4 months).

Mitigation

The alternative retains the proposed action's Phase II plans for a canoe/kayak trail through the constructed wetlands at the eastern end of Sunset Pond. This will create a new recreation opportunity at the site and help offset any losses to warm-water fish angling from the proposed action.

2.9.4 No-Action Alternative

No change will be made to recreation opportunities in the area.

2.10 Existing and Future Development

This section will describe current land use and adjacent zoning and significant impacts to development from each alternative action including mitigation measures to reduce impacts.

2.10.1. Existing Conditions

The current stream between the ponds passes through industrial and institutional zones. This may have an impact on future development by utilizing land that could be used for other purposes. The necessary easements have been obtained from affected property owners. Many adjacent properties are also within the current floodplain and are at risk of property damage during extremely high flows.

2.10.2. Proposed Action

The proposed action will route the new stream channel through some current industrial zoning but mostly through a tract of public lands. The constructed channel will inhibit future development by landowners. This land is currently undeveloped.

The proposed stream channel also intersects the planned route for the Bay to Baker trail proposed by Bellingham Parks and Recreation. The current plan uses roughly the same area the new creek will occupy. Keeping the trail in this area put it at risk of being washed out by a migrating stream channel or flooding.

Mitigation

The project has acquired easements from the current landowners in order to route the stream through their land. The COB eventually intends to acquire as much land along the stream channel as possible to minimize impacts from surrounding and future development.

2.10.3 Alternative Action

The impacts to future development for this alternative are the same as the existing conditions.

Mitigation

Easements are already in place with affected landowners.

2.10.4 No-Action Alternative

The impacts to future development for this alternative are the same as the existing conditions. There are several properties that are at risk of being impacted by flooding (Figure 6).

2.11 Infrastructure

This section will describe current infrastructure impacting the stream and significant impacts to infrastructure from each alternative action including mitigation measures to reduce impacts.

2.11.1.Existing Conditions

Infrastructure impacting the stream channel are surrounding roads and highways, gas lines, storm and wastewater distribution networks and flood swales. Within the valley, multiple berms built for the BNRR or leftover from spoil material generated during the construction of I-5 also impact the stream channel. The stream channel between James Street and I-5 has been straightened to make room for industrial development. This modification removed stream complexity and prevents channel migration. The stream passes through multiple culverts. One under James Street just downstream of Sunset Pond and two underneath I-5. The culverts are considered an impediment for fish passage at high and very low flows(See Fish Passage section).

A railroad grade parallels the creek and there are several other roadway grades that cross through the valley perpendicularly. These structures in the valley have disturbed or replaced previous natural vegetation and wetlands that once dominated the valley. The valley is also surrounded by private residences and industrial development. Grades that are still being maintained, confine the creek preventing stream migration. There is a sewer line that runs along the south bank of Sunset Pond and crosses under the creek near the outlet of the pond.

Figure 15. Photograph showing accelerated velocities at outflow of culverts under Squalicum Parkway.

2.11.2. Proposed Action

This plan requires the addition of a flood control weir between the creek and Sunset Pond, a berm with weir across Bug Lake as well as the installation of three new bridges: two through the RR grade and one at James Street. The James Street bridge will add to conveyance capacity under James Street preventing it from acting like a weir. Flood control weirs will help to control high flows and prevent impacts from flooding by controlling and diverting stream flow.

The Bug Lake berm will isolate the new stream channel from the western part of the lake while the weir will allow high flows to pass into the west section of the lake to prevent flooding. These weirs will attempt to make as much use of surrounding floodplains routing into the lakes as a last resort. Some impacts from weirs include increased dissolved oxygen and reduce stream velocities which can change local stream ecology and lead to increased siltation. Additionally, they can create dangerous water circulation patterns that can trap boats, swimmers, trash, and fish.

Mitigation

The weirs in this project will be constructed out of LWD and will serve the purpose of routing high flows into flood plains north of Sunset Pond as much as possible and into the pond when predetermined levels are reached. The weirs will be designed to only interact with the stream in extremely high flows to avoid current flooding problems. Any potential impacts from the weirs will only occur during heaving flood conditions.

2.11.3. Alternative Action

The alternative action includes modifications to the I-5 culverts by adding baffles to slow velocities. Baffles may cause debris accumulation blocking flow or fish passage. They may also reduce culvert flood flow capacity.

Footbridges over the railroad grade and the construction of the new James Street bridge, will be undertaken regardless of whether the creek re-route goes through as proposed (see Transportation section).

Mitigation

Baffle design will take flow capacities into consideration to ensure proper design for the stream. Debris will be regularly cleaned out by COB Public Works to ensure clear passage for fish.

2.11.4. No-Action Alternative

Footbridges over the railroad grade and the construction of the new James Street bridge, will be undertaken regardless of whether the creek re-route goes through as proposed (see Transportation section).

2.12 Historic and Cultural Preservation

This section will describe current historic and cultural aspects of the area and significant impacts from each alternative action including mitigation measures to reduce impacts.

2.12.1 Existing Conditions

The project site is on lands that have historically fallen under control of the Nooksack Nation. There has never been an archaeological site in the area.

2.12.2 Proposed Action

No known cultural or historical sites or artifacts, as listed in local, state, or national preservation registries, exist in the project site. However, this proposal needed to obtain a permit from State Historic Preservation Officers under Section 106 of the National Historic Preservation Act. Potential impacts include the disruption of unknown cultural or historical sites of artifacts at the project site during the groundbreaking and construction phase of the project. But, such an unearthing is unlikely.

Mitigation

This effect cannot be mitigated for since the effect itself is not certain.

2.13.3 Alternative Action

The alternative action will not require any excavation. Therefore, it is even less likely that objects or sites of historical significance will be inadvertently affected by rerouting the creek.

Mitigation

This effect is insignificant and requires no mitigation.

2.13.3 No Action Alternative

If the proposed action is not taken, there will be no impact on historic sites.

2.14 Elements not significantly affected

Elements of the built environment not affected by the proposed action, alternative action or no-action alternative include:

- Energy and natural resources
- Air (Some dust during construction not expected to be significant)
- Housing
- Light and glare
- Public services
- Utilities

3.0 Significance after Mitigation

3.1 Proposed Action

The impacts to the Bay to Baker trail project cannot be mitigated without significantly reducing the effectiveness of the Squalicum Re-Route project. Moving forward with this action requires Bellingham Parks and Recreation to design an alternative plan that may route users up to a mile out of their way up to the McLeod Rd. intersection. Also, this intersection lacks a crossroad, so improving hiker safety will require modification of the roadway.

Some damage to existing wetlands is inevitable during construction. However, improved riparian vegetation and floodplain characteristics will foster the establishment of health wetlands as natural stream processes take over. The project requires a 1:1 ratio of damaged wetlands to created wetland areas, but the project managers are willingly exceeding this requirement. In other words, there will be more wetlands immediately following construction than currently exist in the area. But, it should be noted that the created wetlands in Sunset Pond may not necessarily provide the same ecological function as a natural wetland.

3.2 Alternative Action

High Flow Conveyance: Even after mitigation measures, channel capacities may not be sufficient to contain high flows especially with the loss of the ponds reservoir function. Wetland areas created in Sunset pond and Bug Lake will improve flood control over the no action alternative. However, heavy flooding could still cause adverse impacts to any surrounding structures or property.

Loss of warm water species will not be mitigated and will result in decreased recreational fishing opportunities.

Other significant impacts will be mitigated by the plan resulting in improved water quality and flow conveyance along the length of the creek. Creating defined channels through the ponds and adding LWD to the creek will improve sediment transport through the stream. This will provide fish habitat and aid passage of native species. Connecting the tributaries to the stream at the location of Sunset Pond will also add to spawning and rearing habitat. However, the stream capacity will be further stressed during high flows as a result of increased input from tributaries.

Some damage to existing wetlands is inevitable during construction. However, improved riparian vegetation should encourage wetland establishment and constructed wetlands in the ponds will contribute to good water quality and habitat for a variety of species.

4.0 Decision Matrixes

The following tables provide a summary of the major environmental impacts and logistical considerations of all project alternatives as discussed within this document.

Table 6. Simplified ecological considerations for decision makers.

	Proposed Action	Alternative Action	No Action
Passage	Treats all identified passage barriers	Mitigation measures improve culverts	Does not address fish passage barriers
Predation	Reduces salmon/warm water fish interactions	Reduces salmon/warm water fish interactions	Does not affect salmon/warm water fish interactions
Juvenile Rearing Habitat	Enhances rearing habitat	Enhances rearing habitat	Does not affect rearing habitat
Adult Spawning Habitat	Enhances spawning habitat	Does not affect spawning habitat	Does not affect spawning habitat
Riparian Habitat Conditions	Enhances riparian conditions	Enhances riparian conditions	Does not affect riparian habitat
Natural Stream Processes	Improves sediment transport, channel complexity, channel length, and floodplain connectivity	Improves sediment transport, channel complexity, and channel length	Does not affect natural stream processes

Table 7. Simplified logistic considerations for decision makers.

	Proposed Action	Alternative Action	No Action
Required Infrastructure Improvements	New bridge at James Street, install two new bridges at RR grade, install flood control weirs	Improvements to existing culverts	No improvements necessary
High Flow Conveyance	Redistributes high flows into new channels, flooding directed into Sunset Pond and Bug Lake	Mitigation measures connect tributaries to Sunset Pond, wetlands improve ability to handle high flow	Does not affect high flow conveyance
Land Acquisition or Owner Agreements needed from	Peacehealth, COB, WDFW, Lakeview Associates, Talbot Real Estate LLC, WSDOT	Peacehealth, COB, WDFW, Lakeview Associates, Talbot Real Estate LLC, WSDOT	No landowner agreements needed
Additional Evaluation and Design Requirements	Design new channel configurations, new bridges, new flood weirs	Culvert modeling, wetlands design	Continued habitat monitoring

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Appendices

Appendix A: List of Tables

Appendix B: List of Figures

Appendix C: Glossary of Technical Terms and Acronyms

Technical Terms

100-year floodplain: the area of inundation associated with a flood event that has a 1% probability of occurring on any given year (FEMA)
Alternative Action: an alternative course of action or as an action resembling the proposed action, but with mitigation measures that the proposed action does not include. (WAC 197–11–792)
Channel: the physical confine of a stream consisting of a bed and stream banks.
Mitigation: Actions included in the proposal to offset specific, adverse environmental effects of the proposed action (WAC 197-11-660(b))
No-Action Alternative: long-term effects if no action or mitigation takes place on the proposal site
Riparian: the interface between land and a water body, typically vegetated for its benefits to ecosystems.
Salmonid: Family of fish that includes salmon, trout, and char.
Significant Impact: a reasonable likelihood of more than a moderate adverse impact on environmental quality (WAC 197-11-794(1))
Thermal loading: increased temperature absorption.
Watershed: an area draining into a lake, river, or other waterbody
Wetland: an area which is saturated by surface or groundwater at a sufficient frequency and duration to support vegetation typically adapted to saturated soil conditions.

Acronyms

ALU: Aquatic Life Uses
BNRR: Burlington Northern Railroad
CFU: Colony Forming Units
COB: City of Bellingham
CWA: Clean Water Act
DO: Dissolved Oxygen
DOE: Department of Ecology
EDNA: Environmental Designation for Noise Abatement
ESA: Endangered Species Act
EIS: Environmental Impact Statement
FEMA: Federal Emergency Management Agency
I-5: Interstate 5
LWD: Large Woody Debris
mg/L: Milligrams per Liter
NMFS: National Marine Fisheries Services
NPDES: National Pollutant Discharge Elimination System
NSEA: Nooksack Salmon Enhancement Association
SEPA: State Environmental Policy Act
TMDL: Total Maximum Daily Load
USACE: United States Army Corps of Engineers
WAC: Washington Administrative Code
WDFW: Washington Department of Fish and Wildlife